weather station

Wind Sensors for the NetLanders

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CNES plans to deploy up to 4 small NetLanders on the surface of Mars as part of the Mars Sample Return Mission, which will be launched in 2005. As part of this mission, the Finnish Meteorological Institute (FMI) will provide the Atmospheric Structure and Meteorology Instrument System (ATMIS). JPL has been invited to provide the wind sensors used by this system. Accurate, time-resolved measurements of the wind velocities near the Martian surface are essential for estimating the transport of heat, mass, and momentum between the Martian surface and atmosphere, and for inferring the effects of these processes on the thermodynamics and general circulation of the Martian atmosphere. These measurements are also needed for studies of the meteorological processes that raise and transport dust in the thin Martian atmosphere. Improved estimates of the amplitudes and the spatial and temporal distribution of near-surface winds would also facilitate the design and operations of future Mars landers because the landing risk, the thermal losses from the lander body, and the deposition and accumulation of dust on solar panels and other lander structures are strongly influenced by the amplitude of the ambient near-surface winds. Because both the speed and direction of the wind can change dramatically at levels near the Martian surface, an ideal wind measuring system would acquire wind measurements from several heights and several locations. The NetLanders will provide the first opportunity provide simultaneous wind measurements from more than two stations on Mars, but it may not be possible to obtain measurements from more than one height within the stringent constraints of the NetLander payload. We will acquire wind velocity measurements at a highest possible level on the NetLander platform, about 1 meter above the ground, at the top of the ATMIS boom. If mass and power are available, we would prefer to install up to two simple wind speed sensors elsewhere on the lander body. Measurements acquired by the Viking and Pathfinder show that wind speeds can also change significantly on time scales as short as 1 to 3 seconds. Fast (0.3 to 1 Hz) sampling is therefore needed to resolve these variations without introducing errors associated with temporal aliasing. In addition, existing data sets show that sampling periods as long as 5 minutes are needed to average out these rapid fluctuations, to produce accurate estimates of the average wind speeds, heat fluxes, or momentum fluxes. Finally, because wind measurement errors can be produced by flow distortions caused by the lander structure or instruments, this contaminated data must be identified and eliminated from averages or flux estimates. To address these sampling issues, we propose to acquire wind measurements with sampling intervals no larger than 3 seconds, for periods no shorter than 5 minutes. This sampling scenario will be repeated as often as possible during each Martian day to resolve diurnal and seasonal variations in the wind speeds. A similar approach was adopted for the Mars Pathfinder and Mars Surveyor '98 Lander missions.

The wind sensor design adopted here was employs the design used on the Mars Surveyor '98 MVACS Met system. This sensor will:

- measure wind speeds between 1 and 100 meters/second with 10% accuracy,
- determine the horizontal wind direction to within +/- 22.5 degrees,
- have a time constant less than 2 seconds in Mars ambient conditions,
- operate at ambient temperatures between -120 and +20 C and pressures from 4 to 12 mbar,
- operate on the Martian surface for the entire nominal mission of the NetLanders with no failure or unrecoverable calibration drifts

To achieve the accuracy requirements over the range of anticipated wind speeds (0 to 100 m/), the NetLander wind velocity sensor employs a fully redundant, constant over-temperature hot wire assembly surrounded by eight 3-element differential thermocouple arrays. The operating principles, structure, and mounting approach will be described further in our presentation.